



Physical Exercise as an Intervention to Improve Quality of Life in People with Autism Spectrum Disorder: A Systematic Review

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ABSTRACT

Autism is a neurodevelopmental disorder that, although physical exercise interventions cannot modify its primary characteristics. It has been observed that they do show good results in variables associated with quality of life.

Objective: To analyze and synthesize the available scientific evidence on the effect of physical exercise in improving quality of life in people with autism, focusing on the identification of the most effective types of physical exercise and their specific benefits in key areas of quality of life, such as physical, emotional, social and cognitive well-being of individuals with autism.

Methods: A search was conducted in three electronic databases (PubMed, Scopus, and psycINFO). Until April 21, 2023. We analyzed clinical trials that will analyze the effects of different interventions on quality of life in the variables of physical, emotional, social and cognitive well-being, comparing which type of intervention produces greater improvements in people with autism.

Results: Eleven studies were evaluated that included a total of 550 participants. It was observed that the interventions in recreational and leisure aspects improved significantly more the quality of life variables of physical, social emotional and cognitive well-being than the intervention in motor skills and sports training. It was also observed that physical exercise improved physical health, reduced stress and anxiety, and provided greater social interaction among participants.

Conclusion: Play/recreational, motor skills and sports training interventions are a safe and effective strategy to improve the quality of life of children with autism. However, further research is recommended to evaluate the long-term effects of physical exercise in this population.

Keywords: Healthy living, Asperger syndrome, Obesity, Sedentary lifestyle

INTRODUCTION

Autism is characterized by difficulties in social communication and restricted and repetitive behavior patterns. According to American Psychiatric Association (APA), 2022 it is defined as "a heterogeneous neurodevelopmental disorder that has highly variable degrees and manifestations." This can be produced by both genetic and environmental causes [1]. This type of disorder, therefore, comprises a series of severe alterations that in most cases affect social interaction, behavior and communication in the first years of life and that will accompany the person throughout his or her life cycle [2].

The latest prevalence data show us that this disease is becoming more and more prevalent, currently according to data provided by the World Health Organization 1 in 100 children is diagnosed with autism spectrum disorder worldwide. These estimates have been increasing over the years and the prevalence is still expected to increase in the coming years.

In Spain, the data show similarities with worldwide data, where approximately 1 in 100 people are affected. However, if we examine different age groups, we can observe that the prevalence is lower in the youngest. So, in children with 18 months

we obtain a prevalence of 0.61%, in children from 1-14 this prevalence rises to 0.85, these data at this age are mainly due to the fact that the symptoms of the disease have not yet developed or these have not been detected correctly. Worldwide, the prevalence level exceeds the global average Redfield et al., was able to demonstrate that 1 in 59 people in North America is affected by such pathology [3].

After analyzing these alarming data, and although we cannot change the characteristics of autism, we must try to improve the quality of life of this type of people. To do so, we must emphasize an early diagnosis of the disease, which will allow us to provide a timely intervention that will generate a positive prognosis both in the short and long term, avoiding any damage that may arise due to inadequate treatment of this disorder.

On the other hand, we must take into account the difficulties that this disorder presents; among them we find that it affects the normal development of their daily life. Some of the most common conditions are hyperactivity or impulsivity, difficulties in communication and in the development of functional skills, as well as restrictive or repetitive behaviors and interests. That is why an individualized treatment to the characteristics of each person is required. For this we must know that there are different types of autism that will be classified according to the following category of the American Psychiatric Association:

- People with autism who present trait of normality
- People with subclinical symptoms (present some features of the pathology)
- Grade 1 (people who need help and treatment)
- Grade 2 (they will need a remarkable help)
- Grade 3 (they need a very remarkable help to be able to solve activities of daily living).

This individualized treatment will depend largely on the type of autism that the person has, since depending on this, he/she may have some symptoms or others. Some of the most common:

Communication difficulties: Although these individuals usually have normal hearing, oral language may be delayed by several years from their normal maturational level, this delay will vary greatly due to the extent and intensity of their symptoms. It is also very likely that they do not use body language or other nonverbal behavior to communicate or to aid their verbal communication. Normally people with autism have difficulty holding or initiating a conversation, but it is common for them to talk to themselves or hold monologues on topics that may be of interest to them. Also a frequent practice is that they tend to ask the same question at different times even after obtaining repeated answers to it (National Institute on Deafness and Other Communication Disorders, 2020) [4].

Socialization: In general, the social maturation of these individuals is usually slower than in individuals with normal development. In early ages tantrums and aggressive behaviors are frequent, as they advance in age these children tend to have few friends and do not tend to share their. The fact that they will be happy or sad with other people will separate them from society and diminish their quality of life.

Motor behavior: The type of behavior they carry out in their daily life distinguishes them from others, because it includes compulsive actions or rituals without a specific purpose. They are frequent in this type of individuals; spinning, swinging, clapping, head banging among many other ways of expressing their motor behavior.

All these difficulties will provide a reduction in the quality of life experienced by the individual, although there are other factors that contribute to this decrease such as the lack of participation in physical activities by these individuals. In relation to this statement, he noted that these individuals will have an increased risk of developing secondary diseases or conditions associated with sedentary lifestyles, which may negatively affect their ability to carry out daily activities.

The diet of these people is another factor to take into account, as it is usually different compared to people with normal development. This is due to the fact that they usually have a greater food limitation, mainly enhanced by the way they perceive the food they consume on a daily basis. This selection is influenced by factors such as texture, color and smell.

These factors lead to a lower consumption of less attractive products such as fruit and vegetables. The sum of the lack of interest in exercising and the low intake of healthy foods such as fruits and vegetables leads to an increase in the individual's weight.

For all these difficulties, it is of vital importance to provide physical exercise habits that can help to cope with all these

symptoms, therefore, in this review we will work different types of interventions, the first of them will be; the recreational/recreational interventions understood as programs designed to promote participation and the development of social, motor and cognitive skills through activities adapted to the personal characteristics of each individual.

Another of the interventions we will be working on will be motor skills interventions, understood as programs designed to promote the development of motor skills. Development and improvement of motor skills in individuals with autism. For this, different methodological approaches are used such as motor games that will be specifically designed to address the motor difficulties associated with autism [5].

Next, the last intervention to be addressed in this review will be those associated with sports activities, understood as the set of strategies and programs designed to promote participation and the development of physical, social and cognitive skills through the practice of sports activities adapted to the interests of people with autism.

All these types of interventions have demonstrated improvements in the quality of life of people with autism. Toscano et al., for their part observed 64 children with autism aged 6-12 years, who, after a training program based on basic coordination and strength exercises for 48 weeks, they managed to improve the general and primary symptoms of this disease in terms of repetitive and stereotyped behavior. Therefore, we can affirm that there is a positive influence of physical exercise. However, Ruggeri et al., states that 83% of children with autism usually have difficulties in learning motor skills, although Fessia et al., suggested that programmed, correctly directed and executed physical exercise allows the individual with autism to alleviate these difficulties in their motor skills. Therefore, it will allow him to acquire a full development which will facilitate a better adaptation to the activities he performs in his daily life.

Therefore, we can affirm that physical exercise generates positive psychological contexts that contribute to personal well-being. Therefore, it is of vital importance to promote physical exercise in this population, Xu et al., highlights that the intervention with sensory integration training obtained a certain effect on the quality of life of people with autism improving mainly the social factors of these people.

However, all these types of interventions produce difficulties when performing the different exercises. In order to overcome possible adaptation difficulties, exercise at lower intensity can be proposed, in addition, it is important to address the lack of motivation that often exists in people with autism towards the physical exercise, as this lack of motivation can lead to the abandonment of the activity, thus to a more sedentary life.

To achieve such motivation, it is crucial to overcome obstacles identified in the study by Reinders et al., where one of the main challenges is to ensure equitable access to different recreational and leisure programs in physical activity for young people with autism [6]. Sometimes, these individuals may face difficulties related to social norms, which generates inequality in the participation and practice of physical exercise compared to typically developing individuals.

All these problems seen so far will make this type of people not consider physical exercise among one of their priorities. Therefore, we must provide different types of physical exercise to raise awareness and motivate these people towards a greater practice of it.

It is emphasized that all these interventions in people with autism will be focused on improving the general health of the individual and their social relationships with other individuals. Although several studies affirm that physical exercise is beneficial to improve some of the symptoms of autism. Consequently, with the present systematic review we will observe and compare which type of intervention achieves better results in quality of life variables, understanding quality of life as physical, emotional, social and cognitive well-being in people with autism.

Therefore, the objective of this systematic review is to analyze and synthesize the available scientific evidence on the effect of physical exercise in improving quality of life in individuals with autism, focusing on identifying the most effective types of physical exercise and their specific benefits in key areas of quality of life, such as physical, emotional, social and cognitive well-being of individuals with autism [7].

MATERIALS AND METHODS

Design: This systematic review study is in the process of being registered in the Prospective International Registry of Systematic Reviews (PROSPERO) as shown in Annex 1 and developed according to the preferred reporting elements for systematic review protocols. The study design was strictly guided by the PICO framework (P=Population, I=Intervention, C=Control, O=Outcome).

Data sources and searches: An exhaustive search was conducted in the following electronic databases: Scopus, PubMed, and PsycINFO. From the beginning of the study until April 21, 2023, no date restrictions were applied in the searches performed. In order to identify articles lost in the database search, a manual reference search was carried out. For this purpose, a systematic search strategy was developed by compiling the key ideas and following an adaptation to PICOT.

- P=Population, people with autism of different ages were analyzed,
- I=Intervention. Different types of physical exercise,
- C=comparison variable. In this analysis, we will examine how different physical exercise interventions may affect the quality of life of people with autism in terms of physical, emotional, social and cognitive well-being.

To do so, we will focus on variables such as physical, emotional, school and social functioning of individuals with autism [8]. Therefore, the objective will be to compare different types of interventions and determine which one achieves more favorable results in these areas. The following search strategy was used for the search in the different databases; (autis* OR asperger*) AND ("physical activity" OR "physical effort" OR "physical exercise" OR exercise) AND ("quality of life" OR PedsQL).

Study selection, data extraction: All the articles retrieved for the present study were managed using the Mendeley Desktop software. The use of this tool allowed the information collected from all the databases included in the current study to be analyzed. In addition, it helped to identify the studies duplicated in our research. All studies were filtered by the same author (MRQ), who conducted a thorough review of the different titles and abstracts of all articles. Articles that met the exclusion and inclusion criteria were retrieved and stored in Mendeley desktop in different folders, depending on the database of provenance of these articles.

For the extraction of the information, several specific tables were designed for this purpose, which contained: Author/s, Year of publication, study design, Participants (age range and diagnosis), description of the intervention, type of exercise, frequency and duration [9].

Inclusion and exclusion criteria for studies: The present research includes randomized and non-randomized trials that carried out structured and supervised physical exercise programs, understanding this physical exercise as a planned, structured and repetitive activity whose main objective is to improve the quality of life in people with autism. Therefore, specific inclusion criteria include:

- Studies analyzing the effect of physical exercise on the quality of life in people with autism in terms of physical, emotional, social and cognitive well-being. To this end, we will focus on variables such as physical, emotional, School and social functioning.
- Studies comparing different levels of quality of life between physically active and non-physically active autistic individuals,
- Studies comparing different types of training with autistic individuals of different ages,
- Studies with a minimum intervention of 3 weeks.

On the other hand, articles were excluded if they included;

- People with pathologies not associated with autism.
- Articles written in a language other than English or Spanish.
- People with autism who were being treated with drugs to improve symptoms of their disease.

Variables: An analysis of the effects of physical exercise on the quality of life of people with autism was carried out, considering the following variables of physical, emotional, social and cognitive well-being of individuals with autism for the analysis of these variables we will focus on physical functioning (levels of physical activity and types of exercise performed), functional functioning (improving the ability to perform physical activities in their daily life) school functioning (school performance and cognitive functioning of the person) and social functioning (relationships with peers, family members).

These variables provide us with significant data on the health of the participants and can serve as reliable indicators to evaluate their quality of life [10]. In addition, they will allow us to obtain information on the impact produced by the different physical exercise interventions in people with autism. To measure these variables, the different studies analyzed used different scales to evaluate the quality of life in this population group.

Risk of bias: The quality and risk of bias of the studies analyzed for the present work was assessed using the Cochrane Risk of Bias Assessment Tool. The assessment of the methodological quality of the selected articles was carried out by the author of this paper. The items taken into account for such analysis were the following:

- Selection bias
- Realization bias
- Stopping bias
- Attrition bias
- Selective description bias of the results.

To obtain the quality of the articles, all the items were summed and if the result was ≤ 2 it was considered high risk, if it was <4 it was considered unclear risk and if it was ≥ 4 it was considered low risk.

RESULTS

Selection of studies: As can be seen in Figure 1, after searching the different electronic databases, 295 studies were identified in 3 different databases. After an initial evaluation of the 295 initial studies, 112 duplicate records and 32 marked as unreadable were eliminated, which left 151 articles available, and after reading the abstract and titles, 21 were excluded [11]. Finally, of those 130 articles after applying the exclusion criteria, 11 studies met all criteria and were included in the review.

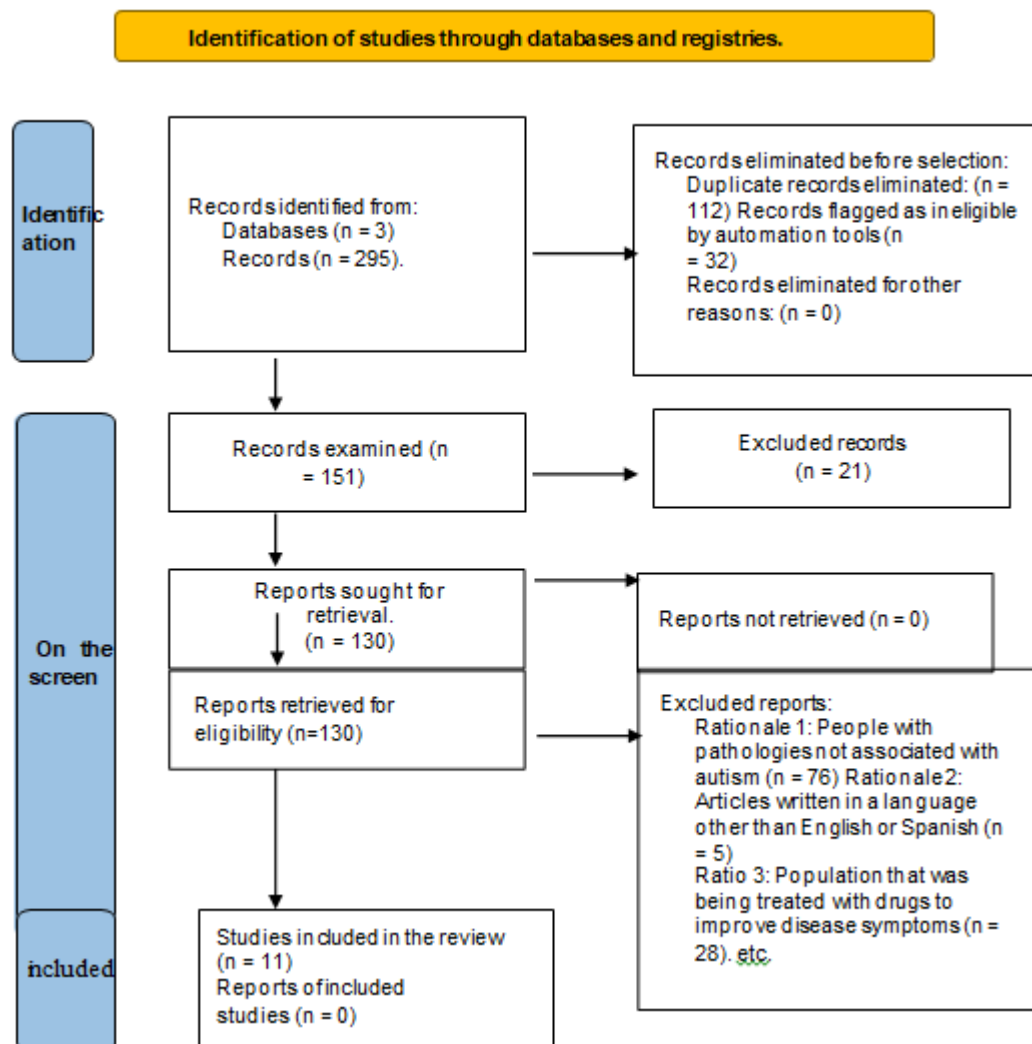


Figure 1: PRISMA flowchart of the articles included in the systematic review

Characteristics of the selected studies: For the present systematic review, the effect of physical exercise on the quality of life of people with ASD was evaluated. Eleven studies were identified that met the inclusion criteria, these included a total of 550 participants, of which 325 were considered control group and 225 experimental group.

The characteristics of the participants are shown in Table 1, and the characteristics of the interventions are included in Table 2. In which we observe that six studies investigated the effects of recreational and sports programs on the quality of life of people with ASD in the variables of social, emotional, school and physical functioning [12]. On the other hand, we found that five studies analyzed the effect of a motor skills intervention on quality of life. The types of interventions were classified into

- Play/recreational activities
- Sports activities
- Motor skills interventions.

Table 1: Participant characteristics

Characteristics of the participants.			
Author/year of publication	Design the of study	Participants (Age Range)	N
(Xu et al., 2019)	ECA	108 with an average age 5.18 ± 2.94 , country of origin of participants: China	Total: 108
			Group A: 50
			Group B: 53
(Zhao & Chen, 2018)	ECA	50 participants ranging in age from 5 to 8 years old, country of origin of participants: USA	Total: 50
			GE: 25
			GC: 25
(Rafie et al., 2017)	ECA	20 participants, with mean age of group 1:(10.3 ± 2.1) and group 2: (11.2 ± 1.9) country of origin of participants: Iran	Total 20
			GE: 10.
			GC 10.
(Gabriels et al., 2015)	ECA	127 participants (ages 6 to 16) country of origin of participants: USA	Total 127.
			GE: 58
			GC: 58
(Caputo et al., 2018)	ECA	26 participants (6 and 12 years old), country of origin of the participants: Italy.	Total 26
			GE: 13
Note: RCT: Randomized Clinical Trial; EG: Experimental Group; CG: Control Group; NR: Not reported; N: Total number of participants; USA: United States			

Table 2: Characteristics of physical exercise programs

Characteristics of physical exercise programs						
Author	Description of the intervention.	Frequency and duration of intervention	Variables studied	Scales used	Differences between groups	Clinical impact
Xu et al.	GE: Routine Treatment + Sensory integration training physical exercise intervention. GC: Treatment of routine	3 months	Behavioral capacity Social interests and social function	CARS and ABC	F. social ↑; F. emotional ↑; F. school ↑	SIT had some effect on the main symptoms in people with autism in the variables analysed by the (CARS) and (ABC) scales
Zhao chen	GE: Regular physical activity; Gc: No performs physical activity	12 weeks divided into 24 sessions	Social interaction, Communication skills.	ABLLS-R; SSIS-RS; PSSIG and VOEQ	Social interaction ↑; Communication skills ↑	A training from 12 weeks showed an overall improvement in the interaction social and communication skills
R. Afieet al.	GE: Motor activity program; GC: Performed regular motor tasks and	10 weeks	Perceptual-motor skills. Gross and fine motor skills of the upper extremities	BOTMP	H.gross and fine motor skills ↑; Running speed ↓; Bilateral	The selected physical exercise training has a significant effect on all motor and perceptual

	parents were asked not to involve the participants in any activities. Regular motor skills.				coordination↓; Response speed↓	variables, except running speed, bilateral coordination and response speed
Gabriels et al.	GE: 10 minutes of horseback riding + motor exercises. GC: Art project	60 minutes once a week for 10 weeks	Hypnotherapy training, Motor skills, Social skills	BOTMP and VABS-II	Social cognition ↑; Social communication ↑; Motor H ↓	A 10-week hypnotherapy with the experimental group failed to improve their motor skills, but did improve their cognition and social communication
Caputo et al.	GE: Multisystemic aquatic therapy. GC: No perform no exercise in the water	45 minutes 1 to 2 per week for 10 months	Multisystemic aquatic therapy training	VABS-II and CARS	H.aquatics ↑; Behavioral H ↑; Emotional ↑ H; H. social ↑	A program to improve aquatic skills in children with ASD improved motor and swimming skills
Najafabadi et al.	GE: Spark; GC: Routine exercises	36 sessions (3 sessions for week from 40 minutes each)	Motor skills Social intervention	GARS-2 and ATEC	Social interaction ↑; Communication ↑; Stereotyped behaviors ↑; Conscientiousness. Sensory cognitive ↑	A 12-week SPARK program improved motor skills, coordination and social interaction
Sarol and Cimen	GE: Directed activities. GC: NR	8 weeks (2 sessions per week of two hours)	Quality of life in its variables of social functionality and school children	PedsQL	F.Social ↑; F.School↑; F.emotional↑; F.physics↑	Recreational physical activity improves physical well-being, emotional and social
Toscano et al.	GE: Basic Exercises coordination strength. GC: Exercises Usual of daily activity	48 weeks (2 sessions per week of 40 minutes)	Metabolic profile, autism traits and quality of life. Perceived.	CHQ-PF 50 and CARS	Individual's weight ↑; Metabolic profile ↑; Symptom profile of TEA↑; Quality of by parents of children with TEA ↑	An exercise program of 48 weeks showed a reduction of symptoms. General and primary autism. This confirms the influence positive of physical exercise on the quality of life of these people.
Jimeno et al.	GE: Exercises aerobics, movement's functional aptitude cardiovascular. GC: NR	8 weeks (1 session weekly the one hour)	Quality of life in the welfare variables physical and psychological	PedsQL	NR	The intervention at least study increase the motor skills and quality of life in variables of psychological functioning
McKeen et al.	GE: Exercises that involves the entire body. GC: NR	12 weeks (2 session weekly 90 minutes)	Skills visual manuals, motor skills fine and coarse and time, quality of reaction, quality of life understood as independence security of the individual	Questionnaire of preparation for the physical activity PAR-Q, PARMED-X	NR	The development from the movement skills can facilitate further participation in programs recreational activities physical
Garcia Villamisar and Dattilo	GE: Program from leisure. GC: NR	NR	Quality from life y stress reduction	QOL	Satisfaction; personal ↑; Independence ↑; Competence ↑; Social interaction ↑	The activity program recreational activities helped to improve the quality of life of people with ASD

Note: NR: Not reported; CG: Control group; GE: Experimental group; CARS: Childhood autism rating; ABC: Autism behavioral check; ABLLS-R Assessment of basic language and learning; SSIS-RS Social skills assessment; PSSIG: Parent semi-structured interview; VOEQ Volunteer open-ended questionnaires; BOTMP: Bruininks-oseretsky motor skills test; VABS-II: Vineland Adaptive Behavior Scale II; GARS-2: Gilliam Autism Rating scale-second edition social interaction subscale; ATEC: Autism Treatment Evaluation Checklist; PedsQL Pediatric Quality of Life Questionnaire; CHQ-PF50: Child Health Questionnaire; PAR-Q: Physical Activity Readiness Questionnaire PARMED-X: Quality of Life Questionnaire; QOL: Spanish version of the Quality of Life Questionnaire; H. Skills; F. functionality; SIT: Sprint Interval Training; SPARK: Selected Group Exercise of Sports, Games and Active Recreation

Risk of bias and level of evidence: Table 3 shows the results of the risk of bias. In seven of the studies the risk of bias revealed that concealment to the experimental group was not possible. Therefore, this generated a high or unclear risk of bias in all but one of the articles [13]. On the other hand, four studies showed a high risk of selection bias because they only included a single group, therefore, no cluster randomization was performed at the beginning of the investigation. In addition, these four studies also had a high risk of attrition and selective outcome description due to incomplete outcome data.

Table 3: Risk of bias

Author del article	Bias of selection	Bias of realization	Bias de detection	Bias of wear and tear	Bias de description	Risk of total bias.
Xu et al.						3 risk unclear
Zhao and Chen						2.5 risk unclear.
Rafie et al.						2.5 risk unclear.
Gabriels et al.						4 risk under
Caputo et al.						2.5 risk unclear.
Najafabadi et al.						2.5 risk unclear.
Sarol and Cimen						1.6 risk high.
Toscano et al.						2.5 risk unclear.
Jimeno						1.6 risk high.
McKeen et al.						1.6 risk high.
Garcia- Villamizar and Dattilo,						1. 6 high risk.
For each color a score was assigned; Green 1 point, yellow 0.5 points and red 0.2 points. To obtain the quality of the articles, all the items were added together and if the result was ≤ 2 it was considered high risk, if it was < 4 it was considered unclear risk and if it was ≥ 4 it was considered low risk. Therefore, and after calculating the mean of all the studies in this paper, we found an unclear risk of bias 2.8.						

Recreational activities: Four studies evaluated the results of a play and recreational activity intervention using different games, ball exercises and different leisure programs. Of these four studies, three of them used a control group and an experimental group to obtain the results while one of them did not report on the distribution of its participants [14]. As for the doses of physical exercise in three studies were three months with sessions ranging from 40 to 60 minutes, while one study did not report the exact number of doses of physical exercise provided.

This type of training found that physical exercise with this type of activities improves physical health, communication, socialization and emotional well-being in people with autism as can be seen in the statistical data of the studies of Zhao and Chen, Garcia-Villamizar and Dattilo, McKeen et al. However in the study of Xu et al., although there are improvements in the variables discussed above these are not significant (Table 4).

Table 4: Difference between before and after play activity training

Training in recreational activities		
Author	Effect size	Increased social skills and symptoms autism
Xu et al.	CARS and ABC tests obtained a value of $P > 0.05$	GE before: 85.72 ± 8.68 After 69.92 ± 11.52 ; GC before: 84.74 ± 9.32 After: 77.56 ± 13.31
Zhao chen et al.	Effect of physical activity training on social interaction. $P < 0.05$	GE: Before 43.95 ± 6.96 After 51.57 ± 5.47 ; GC: Before 44.05 ± 4.66 After 45.15 ± 5.03 .
McKeen et al.	$P < 0.002$	GE: Before 16.0 ± 7.0 After 18 ± 6.7 . GC: NR
Garcia Villamizar and Dattilo	$P < 0.02$	GE: Before 50.59 ± 2.93 After 63.62 ± 8.99 GC: NR
Note: NR: Not reported; CG: Control group; EG: Experimental group		

Motor skills intervention: Three studies evaluated the effect of motor skills in ASD children, mainly activities focused on coordination and strength. Of these three studies, two of them had an experimental group and a control group, while the third study did not report on the control group [15]. As for the doses of physical exercise, they range from 8 to 48 weeks with a variation in the time of the sessions ranging from 40 minutes to 2 hours.

This type of training resulted in improvements in motor coordination, balance and movement capacity, which had a positive impact on people with autism. This was reflected in improved independence and functional autonomy in activities of daily living such as dressing, eating and bathing.

Regarding statistical data, we can observe that an intervention on motor skills will have a significant p-value in the experimental group compared to the control group in the variables of perceptual-motor skills and also significantly improve social intervention and sociability on the other hand, the study of Jimeno, did not show statistical data (Table 5).

Table 5: Difference between before and after motor skills training
Motor skills training improved quality of life

Author	Effect size	Increased social skills and symptoms autism
R.Afie et al.	Perceptual-motor skills p:0.01	GE: Before 36.5 ± 11.2 After 40.3 ± 8.7; GC: Before 37.2 ± 11.3 After 38.1 ± 9.3
Najafabadi et al.	Social intervention and sociability p: 0.01.	GE: Before 20.25 ± 4.81 After 14.58 ± 7.79; GC: Before 19.14 ± 7.81 After 21.28 ± 8.87.
Jimeno et al.	NR	GE: Before 77.17 After 81.52; GC: NR
NR: Not reported; CG: Control group; EG: Experimental group		

Sports activities: Four studies have evaluated the effect of sports activities on the quality of life of participants with ASD. These sports activities consisted mainly of aquatic training, athletics and an exercise program that mixed sports and games [16].

Of these four studies two of them use a GE and a CG to observe the changes that occur in both groups while two other studies did not report CG data, as for the doses of physical activity they range from 8 weeks to 10 months. The duration of the sessions ranges from 45 minutes to 2 hours.

Observing the statistical analysis of these studies, it has been possible to observe an improvement in the social, cognitive and emotional functionality of people with autism due to the fact that in the 4 studies analyzed to check the effect of sports skills training, a positive effect has been obtained in the variables studied by these articles (Table 6).

Table 6: Difference between before and after a sports activity training
Sports training improved quality of life

Author	Effect size	Increased social skills and symptoms autism
Gabriels, et al.	Social cognition p: .005 Social communication p: .003	GE: Before 95 ± 35.53; After 107.0 ± 37.60. GC: Before 102.9 ± 28.55; After 108.8 ± 30.78
Caputo, et al.	size effect on the health psychosocial p: .064	GE: Before 59.85 ± 7.84; After 66.15 ± 11.39. GC: Before 58.54 ± 5.76; After 61 ± 7.25
Arol and Cimen	Physical Functionality t= 3.40; Emotional Functionality t= 2.63; Social functionality t= 1.05; Effect size t= 3.21	GE: 84.8% improved while 15.2% did not. GC: NR
Toscano, et al.	Effect size on physical health: +1.05; Effect size in psychosocial health: +1.66	GE: Before 41.7; After 40.2. GC: Before 40.3; After 39.9

DISCUSSION

Selection of studies: The objectives of the present study were to analyze and discuss, by means of a systematic review, the effects of interventions related to physical exercise and their relationship with quality of life in people with autism.

To meet these objectives, a comprehensive search was conducted using rigorous selection criteria. Although the limited availability of specific research on playful training, skills training motor skills and sports training could have restricted the number of studies included. On the other hand, the language limitation may have introduced bias in obtaining the results.

Interventions in recreational/recreational activities: As can be seen from the results obtained in the present systematic review, each type of training produces different types of improvements, although evidence has been found that recreational play training is more effective than motor skills training and sports activity training in children with autism.

Other studies analyzed corroborate the results obtained since these activities in terms of quality of life provide opportunities to interact with other individuals and to practice social skills, due to the fact that they encourage shared play, verbal and nonverbal communication, turn-taking and the development of different skills that will help them develop both socially and intellectually [17]. In addition, by participating in games and recreational activities, these types of people improve their social skills and feel more included in their communities.

Therefore, a possible explanation for these differences based on scientific evidence may be that this type of training focuses on intrinsic motivation and enjoyment of the individual, which may lead to greater motor participation and engagement. In addition, playful games and activities may provide opportunities to practice a variety of motor and social skills in a more natural and less structured way.

Motor skills intervention: On the other hand, motor skills training have been shown in the present review to have a positive impact on the quality of life of people with autism. Several studies included in this review have demonstrated significant improvements in aspects related to quality of life.

On the other hand, it has been seen in several studies that participation in various games or activities carried out to improve motor skills and coordination in people with autism, have had a direct impact on autonomy and independence in daily activities, which in turn will contribute to improving the quality of life of these people [18]. Additionally, motor skills have also provided a solid foundation for social interaction and cooperative play, which facilitates participation in group activities and strengthens communication skills.

Another relevant aspect is that motor skills intervention can promote, although to a lesser extent than the other two interventions discussed in this review, social interaction and integration with other individuals. These changes are produced mainly because interacting with other peers will promote the learning of social skills and nonverbal communication. This directly contributes to the improvement of their quality of life.

Interventions with sports activities: This systematic review supports the notion that the practice of sports activities has a positive impact on the quality of life of people with autism. Participation in these activities provides opportunities to improve motor skills, coordination and muscle strength. In addition, sport promotes social interaction, communication between individuals and teamwork, which contributes to favor social skills and self-esteem in people with autism.

A possible scientific explanation that supports the idea that we have been defending in our systematic review is that this type of activities produce in individuals with autism an increase in their self-esteem and confidence, due to the fact that they will establish different achievable goals, overcome different challenges, as well as experience success in achieving their goals. Therefore, the perception of personal competence will be strengthened and a positive attitude towards oneself will be promoted [19]. This provides a positive impact on the self-image and self-confidence of the person with autism, thus improving their quality of life.

One possible explanation for the positive impact of sports activities for people with autism lies in their ability to be adapted and customized to the individual needs of each person. These activities can be adjusted to specifically meet the requirements of each participant. In addition, it is important to note that adequate supervision is required during these types of activities which will provide the individual with greater safety and increased well-being.

Physical exercise and its influence on people with autism: To summarize everything seen above, it is highlighted that physical exercise can be an effective tool to improve the quality of life in people with autism for several reasons. First, exercise can improve motor function, coordination, speed of response in the following items, which can help people with autism to participate more fully in social and daily activities.

On the other hand, other studies analyzed in the present review demonstrated that physical exercise can improve communication and behavior by reducing anxiety and stress levels in the individual as demonstrated by the articles.

In addition, it was found that physical exercise can reduce the general and primary symptoms of autism, which confirms the positive influence of this on the quality of life of these people, this improvement can be observed in studies in the latter article it was shown that a 48-week exercise program reduces the stereotyped behaviors of these people and therefore reduces the general and primary symptoms of autism.

Although it should be noted that the results presented above are promising, it is important to mention that many of the studies included in the present systematic review had methodological limitations, such as a small sample size and a lack of control of variables or confounding variables, which increased the risk of bias of these articles [20]. Therefore, more well-designed studies are needed to determine the effectiveness of different types of exercise in different subgroups of people with autism.

Therefore, the results of the present systematic review suggest that different types of intervention are a tool that should be considered to improve the quality of life in people with autism, by improving motor function, communication, behavior, and general and primary symptoms of autism. However, more rigorous studies are needed to confirm these findings and to determine the effectiveness of different types of exercise in different groups of people with autism.

Strengths and limitations: The strengths of the present systematic review will be several:

- A comparative analysis of different interventions was carried out to compare and contrast different types of interventions.
- A PICO strategy was used to justify the included designs, to perform study selection and for data extraction.

As for the limitations of the present study, there will be several:

- Analysis of heterogeneous studies, the inclusion of studies from different approaches and methodologies provides a more complete and diverse view of the different ways to improve quality of life.
- Variability in comparisons, different studies may have used different types of play interventions, motor skills and sports activities, which may make it difficult to compare results.
- The duration of follow-up, in some studies this follow-up lasted 8 to 10 weeks which limits the ability to assess the long-term effectiveness of the interventions.

CONCLUSION

The present systematic review has examined and synthesized the available scientific evidence regarding the impact of different physical exercise interventions on improving quality of life in people with autism. The results consistently support the efficacy of physical exercise in several key areas of quality of life. Of life of individuals with autism, including physical, emotional, social and cognitive well-being.

As for the most effective type of physical exercise, intervention in recreational activities stands out as the most beneficial, since it has shown significant benefits in different aspects of quality of life in people with autism, such as improvements in physical health, mood, social interaction, as well as in the cognitive abilities of individuals with autism.

As for the interventions in motor skills and sports activities, it should be noted that physical exercise has succeeded in promoting relaxation and reducing anxiety, as well as disruptive behaviors in people with autism.

These findings support the importance of implementing physical exercise programs tailored to the individual needs of each person with autism in order to efficiently improve their quality of life. However, they emphasize the need for additional research to further explore the underlying mechanisms and long-term effects of physical exercise in this population.

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